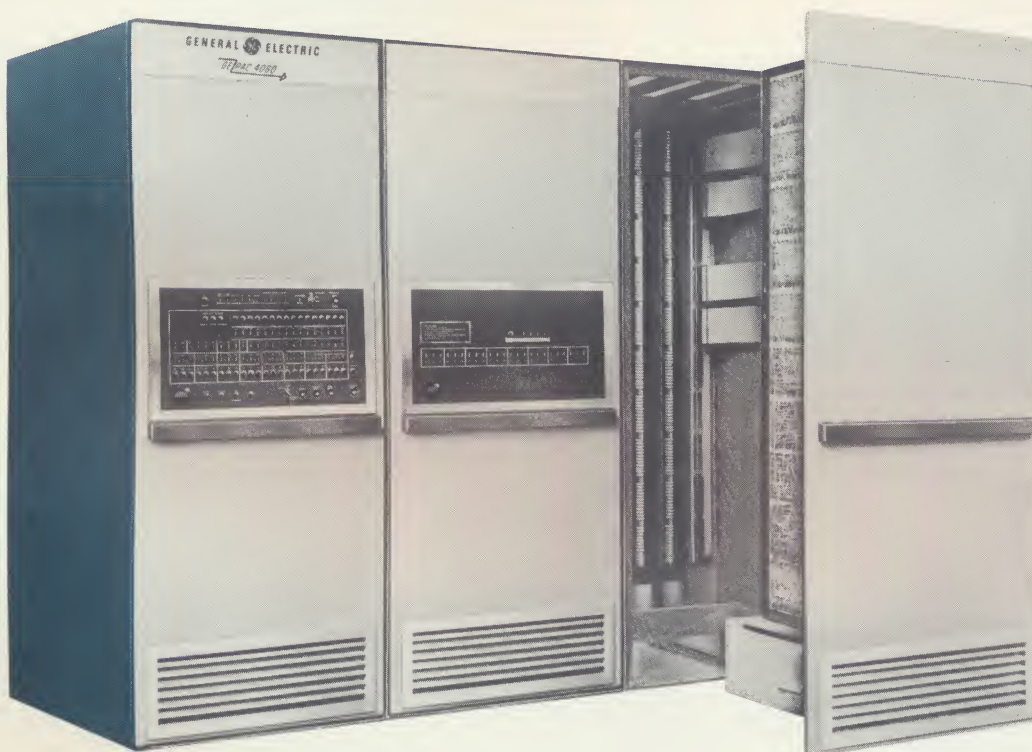


Another GE/PAC 4000 process computer...

GE/PAC* 4060

combines with Directo-Matic* II control for Integrated Process Control

* Registered trademark of General Electric Co.



**INDUSTRY'S
LARGEST,
MOST
POWERFUL
COMPUTER
DESIGNED
SPECIFICALLY
FOR
PROCESS
CONTROL**

**HIGH SPEED • ADVANCED DESIGN • REAL TIME ORIENTED • LARGE
PERFORMANCE AT LOW COST • VARIABLE FIELD OPERATIONS •
CIRCULAR LIST PROCESSING • COMPLETE FIELD ARITHMETIC •
MODULAR • FULLY COMPATIBLE WITH ENTIRE *GE/PAC* LINE**

GENERAL  ELECTRIC

Why **GE/PAC 4060** is today's most powerful computer system designed especially for process control!

SPEED: The use of a 1.7-microsecond memory and parallel arithmetic unit provides the speed necessary for today's real-time process control with power to spare. The capability of GE/PAC 4060 simplifies real-time programming. Its speed normally permits a task to be completed or a subroutine finished without interruption. Its process-oriented design and software give the programmer the exact tools he needs to apply the computer easily to the tasks assigned.

SIZE: Expansion capability up to 65,536 words of core memory and the 24-bit word with six modes of arithmetic allow result precision and execution times to be optimized. Together with powerful programming features and special logic capabilities, these make GE/PAC 4060 the most advanced process computer system today.

INPUT/OUTPUT: Programming of input/output operations is virtually eliminated by a powerful new technique that permits the programmer to treat input/output as an independent function, accomplished by the computer hardware. The eight input/output channels from the arithmetic unit may be used in this mode or under direct program control if desired. Four memory channels are also available for direct access peripheral controllers.

CIRCULAR LIST PROCESSING: The GE/PAC 4060 brings to computer technology a new concept for automatic addressing—*circular lists*—that simplifies process control tasks. The computer implements automatically the time-shared control of numerous process actions in required priority. Use of circular lists saves time and memory and simplifies the organization of the system program.

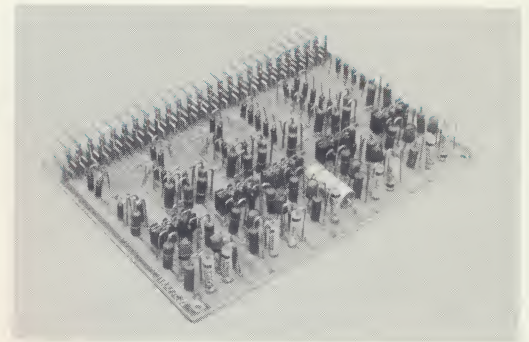
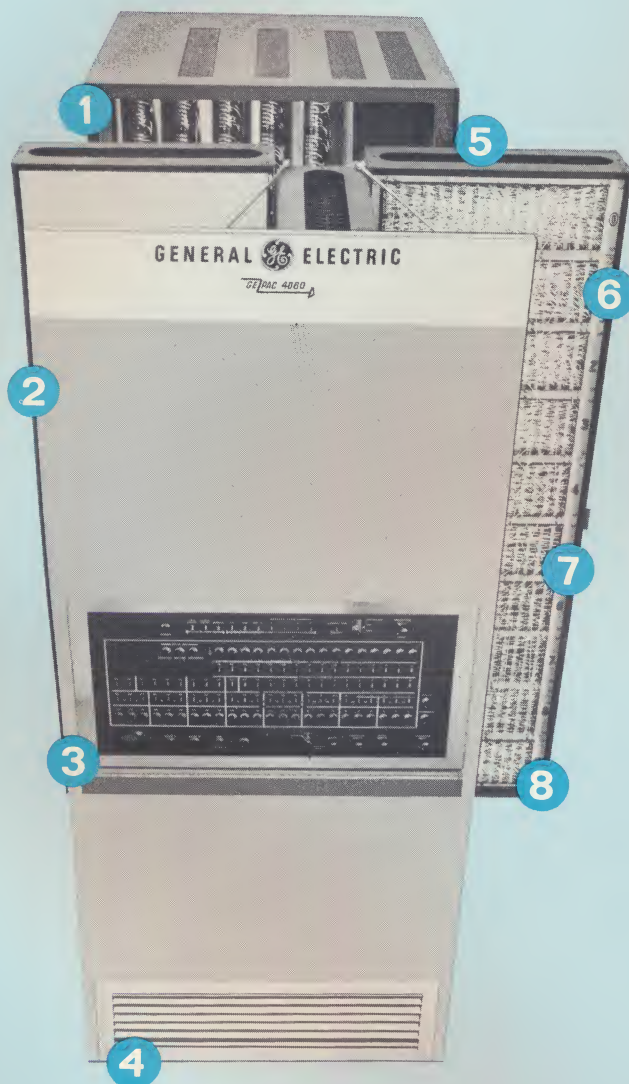
VARIABLE FIELD OPERATIONS: GE/PAC 4060 improves memory usage and eases programming tasks through completely automating Variable Field Operations. VFO is the ability to select and work with a defined group of bits out of any computer word. One example of this new technique is high-speed *masked search* of core memory with GE/PAC 4060, in which the computer locates rapidly all the items in a given list as specified by the field, or mask.

HIGH-SPEED FLOATING-POINT ARITHMETIC: The GE/PAC 4060, with two modes of floating-point arithmetic, gives the programmer a tool with both the speed and accuracy required to simplify numerical operations without sacrifice of memory space. With floating-point, it is unnecessary for him to do the tedious organization and scaling of numbers needed when using fixed-point arithmetic.

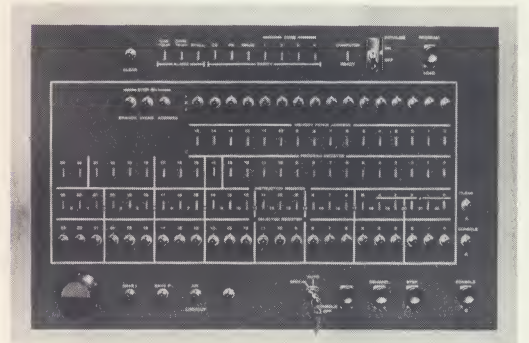
COMPATIBLE SOFTWARE: The programs written for other GE/PAC systems will run without need of modification on the GE/PAC 4060 computer. This makes it possible to expand your system without excessive expense in reprogramming or program training. Send for bulletins GEA-7288 and GEA-8021 for complete information on compatible software for GE/PAC 4000 computers.



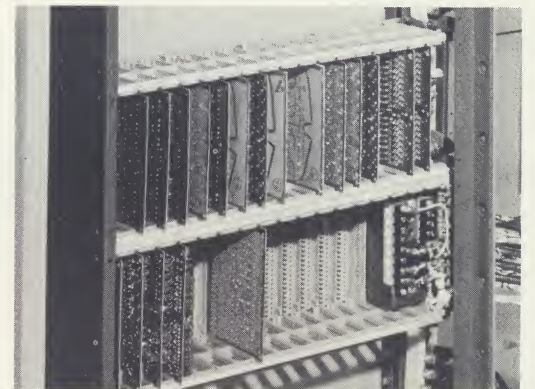
CIRCUITRY AND CONSTRUCTION
SPEED AND SIMPLIFY INSTALLATION,
SAVE SPACE AND MAINTENANCE



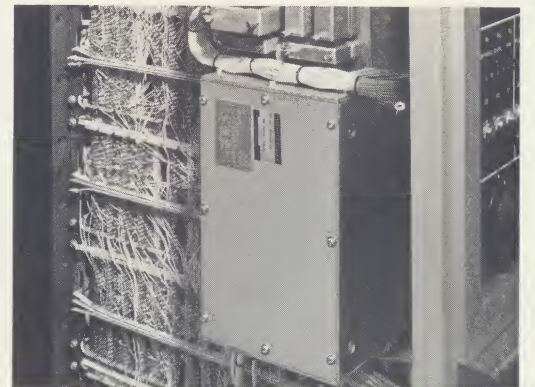
Printed wiring board with silicon semiconductors provides higher density and saves space.



Displays and controls shown provide the programmer and the maintenance man the means for program or hardware troubleshooting.



Standard modules make GE/PAC 4060 extremely versatile. Printed wiring boards slide into rack, have plug-in connections.



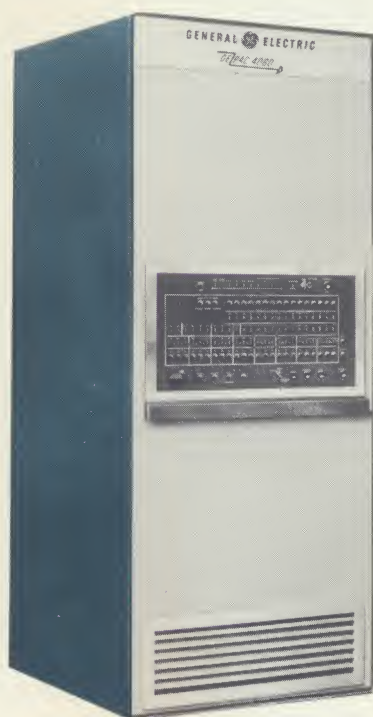
High-speed magnetic core memory with 24-bit word and 1.7-microsecond speed is available from 4096 to 65,536 words. Core is sealed and temperature regulated to permit operation without adjustment over complete temperature range.

- 1 FIELD TERMINATIONS**—and input multiplexing are located at the left or rear of the cabinet interior. Normal industrial wiring for a wide range of signals from many types of sensors can be accommodated. Expansion for additional inputs in the future is available.
- 2 INDUSTRIAL CONSTRUCTION**—sturdy, yet lightweight unit is built to withstand a wide range of environments. Individual cabinets are 32" wide x 36" deep x 76" high.
- 3 ROLL-OUT ASSEMBLY**—draws out of cabinet easily by lifting the front-mounted handle and pulling. A track at the bottom of the cabinet guides the assembly and locks it when fully open.
- 4 BLOWER AND VENTILATION SYSTEM**—Internal air flow through vent in front, in and around pages of components, and out of the top, eliminates need for special cooling in applications up to 131 F.
- 5 HINGED PAGES**—Printed wiring boards and modules are mounted on three pages, two hinged on either side of a stationary center unit, providing easy access.
- 6 MODULAR CONCEPT**—Each function is performed in a standard module. This permits incorporation of only those functions you initially need, yet permits easy expansion as your automation requirements grow.
- 7 PRINTED WIRING BOARDS**—Boards are mounted in 10 rows of 17 cards per row in frames on each page. Each board slides in and plugs into a connector. Interconnection between boards is on the back of each page.
- 8 SILICON DIODES AND TRANSISTORS**—Temperature operating range is increased by the use of silicon semiconductors throughout. GE/PAC 4060 operates reliably at ambient temperatures from 32 to 131 F.



PROCESS AUTOMATION COMPUTER

OPERATING SPECIFICATIONS



CENTRAL PROCESSOR

COMPUTER TYPE: Digital, binary, fixed point

CIRCUITRY: Solid state, silicon semiconductors throughout

STORAGE, WORKING: Temperature-regulated magnetic core in 1.7 microseconds — 4096, 8192, 12,288, 16,384, 24,576, 32,768, 49,152 and 65,536 words (2.24 microseconds above 16K)

STORAGE, BACKUP: Magnetic drum — 16,384 to 262,144 words, average access 8 milliseconds

TRANSFER TIME BETWEEN DRUM AND CORE: 1 to 512 words in 33.3 milliseconds. Effective transfer rate: 61,000 char/sec

PARITY CHECKING: Provided both core and drum

WORD SIZE: 24-bits plus parity

INTERRUPTS: Up to 128 high performance, up to 2000 total

INSTRUCTIONS (including extended functions commands)

Arithmetic	22
Loop control	6
Program control	16
I/O control	11
General	22
Word logical	10
Bit logical	5
Testing	21
Total	113

OPERATING TIMES (in microseconds) using 1.7 microsecond memory:

Memory read-write cycle	1.7
Add partial word	1.7
Add full word	3.4
Add double word	5.1
Multiply (average)	16
Divide	28
Logical commands	3.4
Circular list	10
Variable field	11.5
Floating add/subtract	95
Floating multiply/divide	133
Memory input/output rate to external registers (words)	667KC

OPTIONAL FLOATING POINT ARITHMETIC UNIT

OPERATIONAL REQUIREMENTS: Power — 115/230 volts $\pm 10\%$, three-wire, single-phase, 50 or 60 cps ± 1 cycle (Optional $\pm 3\%$)

POWER USAGE: Central processor 2500 W, typical system 7 KW

ENVIRONMENT: Temperature range, 32 F to 131 F; Relative humidity, 5% to 95%

PHYSICAL CHARACTERISTICS: Cabinet dimensions 32" wide, 36" deep, 76" high (basic central processor requires two cabinets)
Weight — approximately 1000 pounds per cabinet
Packaging — Rugged industrial construction meets NEMA Type I standards. Full access from the front; circuitry mounted on roll-out assembly. Sensor inputs and switching at rear and side of cabinet. Can be installed against wall, in corner, or recessed area. Programmer's console on front of roll-out assembly.

OPERATOR COMMUNICATION:

Typewriter — fixed carriage, 15 char/sec
Typewriter — movable carriage, or teletype 10 char/sec
Paper-tape reader — 100 char/sec
Paper-tape punch — 110 char/sec
Card reader — 70 cards/min
Operator's console — many standard models available
Digital clock — memory clock in hours, minutes, seconds

Display devices — trend recorders, annunciators

PROCESS COMMUNICATION:

Analog inputs — 16 to 1024 or more at 40 to 110 pt/sec
Analog accuracy — 0.1% of full scale at 50 MV
Analog ranges — 10 millivolts to 8 volts
Contact inputs — groups of 20 at computer execution rates
Pulse inputs — any number at computer execution rates

*For more information about GE/PAC 4060 process computers,
contact your nearest General Electric Sales Office.*



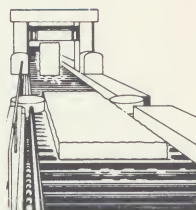
PROCESS COMPUTER BUSINESS SECTION

PHOENIX, ARIZONA

BENEFITS EVERY MAJOR INDUSTRY

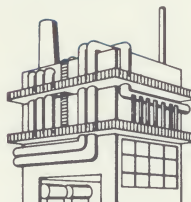
Automatic reporting, monitoring and process control with the GE/PAC 4000 line means dollar savings through smoother operation, improved product quality, increased production, lower costs, better management reports, and increased process knowledge. GE/PAC can benefit every major industry where needs like these exist. Typical of the industries where the broadened scope of GE/PAC 4060 can contribute significant operating economies are the following:

STEEL



GE/PAC 4060 permits a broadened scope for computer application to steel processes. Its speed, computing and input/output capability make possible higher levels of control including a greater degree of direct digital control. Today's higher speeds for rolling mills, increasing trend toward dynamic processes (such as the oxygen converter) and the pressure for improved quality and lower cost, permit a computer with the multi-talents of GE/PAC 4060 to offer users additional benefits. GE/PAC 4060 enables you, with one machine, to control more than one process in a mill complex.

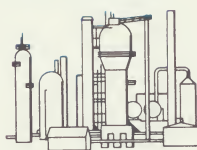
UTILITIES



The addition of GE/PAC 4060 means that the GE/PAC line can now handle applications from simple data logging to entire plant control integrated if desired into the total business information system.

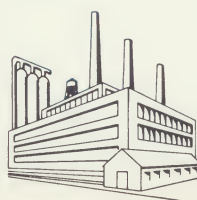
The complete software packages and the scientific capabilities of GE/PAC 4060, coupled with its on-line process control capabilities, give it increased superiority for economic load dispatching. It not only handles the power regulation and economic dispatch jobs, but also has time for the functions of operations control and operations planning, i.e., necessary calculations in accordance with interchange agreements and unit commitment scheduling.

CHEMICAL- PETROLEUM



The GE/PAC 4060 process computer has the high speed and reliable performance needed for the most complex process modeling jobs and sophisticated optimizing techniques. The balance between hardware performance, ease of programming, and cost makes it suitable over a wide range of process applications. Where desired, speed and reliability permit direct digital control on a number of loops.

PAPER



GE/PAC 4060 has the performance, speed and programming tools to process rapidly mill operating and maintenance data for closer control of the varying factors affecting product costs and quality. Major management decisions can be made daily, operator decisions in minutes. By reducing the time required for grade changes on the paper machine, GE/PAC 4060 minimizes costly downtime. The excellent scientific computing capability lends itself to studies of process optimization as well as the complex control functions often required.

GE/PAC 4000

PROCESS COMPUTERS COMBINE POWER, SPEED AND COMPATIBILITY FOR MORE ECONOMICAL PROCESS CONTROL

The GE/PAC 4060 system, most powerful member of the GE/PAC line of process computers, fills the need for top-of-the-line, high-performance process computers that are completely compatible with (1) other GE/PAC 4000 hardware and software, (2) General Electric Directo-Matic II controls, forming Integrated Process Control, (3) GE/MAC process instruments, (4) GE/TAC telemetering and supervisory control, and (5) G-E sensors. This compatibility of components and circuitry eliminates expensive interfacing equipment and facilitates system design and engineering. GE/PAC 4000 process computers can also be integrated with various general purpose computers to form integrated business data processing and process control systems.

SMALL INITIAL INVESTMENT—You buy only the modules to do the functions initially required. GE/PAC 4000 computers operate on standard 230/115-volt, 3-wire, a-c power. They require no special enclosure nor refrigeration under normal conditions, operating in a temperature range of 32 to 131 F and humidity range of 5 to 95 percent. Compact size reduces floor space requirements.

ECONOMICAL FIELD EXPANSION—The modularity of GE/PAC components permits easy, economical expansion of your system in the field. As your automation needs grow with your process, GE/PAC 4000 computers permit you to add to your system and still preserve your initial investment.

BETTER MANAGEMENT REPORTS—GE/PAC computers present accurate, up-to-date process operation data in real-time, that is, as the operation takes place. You save money when decisions are based on current information enabling you to operate more efficiently. For instance, productivity is accurately measured and operator efficiency can be rewarded or corrected.

Process sensor signals, scanned automatically by GE/PAC, provide raw data that is converted into useful information by GE/PAC. It can be printed out under computer control to provide complete, factual records of plant operation. This information can be prepared by GE/PAC for direct use by accounting and for the plant manager in terms of throughput, fuel efficiencies, or other calculated results.

MORE CONSISTENT OPERATION—GE/PAC compares deviations in actual process operation with ideal operation under various conditions and prints out "operator guides." This information saves you money by permitting more consistent plant operation.

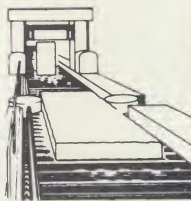
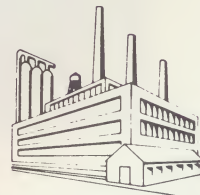
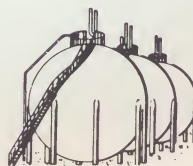
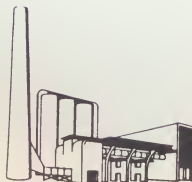
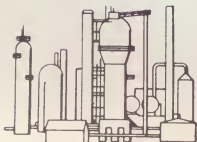
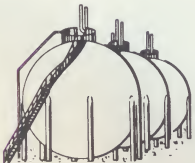
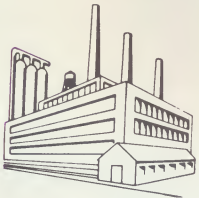
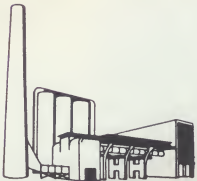
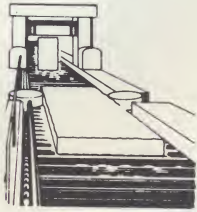
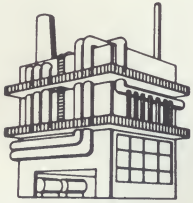
GE/PAC continually "looks at" many process variables. If any variables go "off normal," it immediately warns the operator by means of a display panel alarm or typewriter printout, so corrections can be made before they become serious.

AUTOMATIC PROCESS CONTROL—The computer can provide set-point references to process controllers or directly actuate process valves and motors. Computer control saves you money by optimizing process operation, smoothing process fluctuations, and more efficient use of personnel.

TYPICAL FUNCTIONS—The GE/PAC concept lets you start with minimum core memory, arithmetic and control unit, typewriter, and tape reader and punch. This system can perform off-line functions such as data processing, optimizing calculations, and engineering analysis.

By adding a scanner and input-output unit, you can put the computer on-line. On-line functions can include automatic logging, alarming, performance analysis, monitoring, controlling, continuous testing, checkout, and evaluation, as well as providing computer calculated guides for the operator.

GLOSSARY OF PROCESS COMPUTER TERMS



PROCESS COMPUTER BUSINESS SECTION

PHOENIX, ARIZONA

GENERAL  ELECTRIC



Installation of a GE/PAC 4040 Process Computer and peripherals

ABSOLUTE CODING

See Coding, Absolute

ACCESS, RANDOM

See Memory, Random Access

ACCESS TIME

The time interval between the instant at which information is: (a) called for from storage and the instant at which delivery is completed, i. e., the read time; or (b) ready for storage and the instant at which storage is completed, i. e., the write time.

ACCUMULATOR

A storage register which receives the sum from the adder. The actual electronic arithmetic operations are performed in the adder.

ACCURACY

The state of being accurate.

ACCURATE

In exact conformity to some standard.

ACTION

A control action. That which is done to regulate the controlling element in a process or operation. The action ranges from "on" and "off" to derivative and rate types of action.

ACTIVITY

Any information which results in use or modification of the information in a master file.

ACTIVITY RATIO

The fraction of the records in a master file which have activity in a given period.

ADDEND

See sum.

ADDER

A device capable of forming the sum of two or more digital quantities.

ADDRESS

A number which designates a register, a memory location or a device.

ADDRESS, ABSOLUTE

An operand address which: 1) is independent of the instruction address, and 2) specifies an operand whose memory address is also independent of the instruction address.

ADDRESS, EFFECTIVE (OPERAND)

The true operand (or memory address of the operand) of an instruction. See address modification.

ADDRESS, INDIRECT

An address of a location that contains the address of the operand rather than the operand itself.

ADDRESS, INSTRUCTION

An instruction's memory address. The symbol * is frequently used to designate this address.

ADDRESS, MEMORY

The address in memory of the location containing an instruction or operand.

ADDRESS, OPERAND

The contents of the instruction's address field.

ADDRESS, RELATIVE

An operand address which: 1) is independent of the instruction address, and 2) specifies an operand whose memory address is dependent upon the instruction address. The difference between the operand's memory address and the instruction address is a constant.

ADDRESS, SYMBOLIC

See Label

ADDRESS, TRUNCATED

An operand address whose address field is shorter than the programmable memory's Memory Address Register. The remaining fields in the instruction determine the algorithm for computing an effective address from the truncated address. A GE/PAC Instruction's index address and its operand address are examples of truncated addresses.

ADDRESS FIELD

That part of an instruction or word containing an address or operand.

ADDRESS MODIFICATION

The hardware action of computing an instruction's effective operand address from its operand address by some sequence of the following operations as prescribed within the instruction:

1. Indexing:
Adding an index to the address.
2. Derelativization:
Adding a base address to the address.
3. Indirect addressing:
Using the intermediate computed address to obtain another address from memory.

ADDRESSABILITY, MEMORY

A measure of capability and ease of programming used in evaluating computers. The maximum number of locations specifiable by a non-indexed instruction using the instruction's minimum execution time. GE/PAC's memory addressability is 16,384 words absolutely addressed and 16,384 words relatively addressed.

ALARM

An audible or visible signal that indicates an abnormal or out-of-limits condition in the plant or control system. Not necessarily a dangerous condition, but one that requires additional attention.

ALGOL

Algebraic Oriented Language -

An international algebraic procedural language for a computer programming system.

ALGORITHM

A fixed step-by-step procedure for accomplishing a given result.

ALPHANUMERIC

Characters which are either letters of the alphabet, numerals, or special symbols.

ANALOG COMPUTER

A computer which represents numerical quantities as electrical and physical variables. Solutions to mathematical problems are accomplished by manipulating these variables.

AND

A logical operator which has the property such that if X and Y are two logic variables, then the function "X AND Y" is defined by the following table:

X	Y	X <u>AND</u> Y
0	0	0
0	1	0
1	0	0
1	1	1

The AND operator is usually represented in electrical notation by a centered dot ".", and in FORTRAN programming notation by an asterisk "*" within a Boolean expression.

AND - GATE

A signal circuit with two or more input wires; the output wire gives a signal only if all input wires receive coincident signals.

ARITHMETIC UNIT

That portion of the hardware of an automatic computer where arithmetic and logical operations are performed.

ASCII

A contraction for "American Standard Code for Information Interchange". This proposed standard defines the graphics and codes for a character set to be used for information interchange between equipments of different manufacturers.

ASSEMBLE

To transform assembly language into absolute coding.

ASSEMBLY LANGUAGE

See Coding, Symbolic

ASSEMBLY PROGRAM

The processor portion of an assembly system.

ASSERTION BOX

A block or figure on a flow chart which explains the action or contents of some other portion of the flow chart.

ATTENUATE

To obtain a fractional part, or reduction in amplitude, of an action or signal.

AUGEND

See Sum

AUXILIARY STORAGE

See Memory, Bulk Storage

BAND

Gamut or range of frequency spectrum between two defined limits.

BANDPASS FILTER

A filter which allows free passage to frequencies within its designed range and which effectively bars passage to all outside that range. A filter having a single transmission band.

BANDWIDTH

Bandwidth is the difference between the limiting frequencies of a continuous frequency band. The bandwidth of a device is the difference between the limiting frequencies within which performance in respect to some characteristic falls within specified limits.

BASE

A number base; a quantity used implicitly to define some system of representing numbers by positional notation; radix.

BASE ADDRESS

See Coding, derelativized; Address modification. In GE/PAC coding, an instruction's base address is its memory address.

BAUD

Bits per second. A contraction of the name Baudot who was an early pioneer in data communications and the originator of the Baudot Code. Baud is normally used as the unit for bandwidth in data communications. For instance, 180 baud line is a transmission line capable of handling 180 bits per second.

BAUDOT CODE

The system for encoding symbols in printing telegraphy. Also referred to as "5-Bit Code" and "5-Channel Code" and "5-Unit Code"; "Teletype Code".

BINARY

Pertaining to numbers expressed in the Base 2 number system.

BINARY CODED DECIMAL (BCD)

A term commonly given the codes of a character set.

BINARY SEARCH

An algorithm for searching an ordered table to find a particular item. The procedure involves selecting the upper or lower half of the table based upon an examination of its midpoint item. It then selects the upper or lower portion of the previously selected portion.

BIT

A contraction of binary digit. See Digit.

BLANK

The character which results in memory when an input record such as a card column which contains no punches is read; the character-code which will result in the printing of nothing in a given position. When associated with paper tape, blank refers to a section of tape which has only the sprocket hole punched.

BLOCK

A group of words or characters considered or transported as a unit, particularly with reference to input and output. The term is used sometimes in connection with magnetic tape as a synonym for record, or to refer to grouped records on tape.

BLOCK

To fill the unused remaining words in a block with a prescribed constant.

BLOCK DIAGRAM

A schematic of a hardware system showing major hardware modules, their registers and interconnecting information paths. A flow chart (see flow chart).

BOOLEAN

Pertaining to logic quantities.

BOOLEAN ALGEBRA

An algebra named for George Boole. This algebra is similar in form to ordinary algebra, but with classes, propositions, yes/no criteria, and so forth, for variables rather than numeric quantities. It includes the operators AND, OR, NOT, EXCEPT, IF, THEN.

BOOLEAN EXPRESSION

In FORTRAN, a quantity expressed as the result of Boolean operations AND, OR, and NOT upon Boolean variables.

BOOTSTRAP

A short sequence of instructions, which when entered into the computer's programmable memory will operate a bulk storage memory device to load the programmable memory with a larger more sophisticated program -- usually a loader program.

BRANCH

An instruction which when executed may cause the arithmetic and control unit to obtain the next instruction from some location other than the next sequential location. A branch is one of two types: Conditional, Unconditional.

BREAK

To break, in a communication circuit, is for the receiving operator or listening subscriber to interrupt the sending operator or talking subscriber and take control of the circuit. The term is used especially in connection with half-duplex telegraph circuits and two-way telephone circuits equipped with voice-operated devices.

BREAKPOINT

A point of special interest in a routine requiring man communication prior to continuance.

BUFFER

A device which stores information temporarily during data transfers.

BYTE

The smallest number of bits that can be read from a memory into the computer's arithmetic and control unit by a single instruction. A GE/PAC 4040 byte is one word; a GE/PAC 4050/4060 byte is one bit.

CABLE

A cable is an assembly of one or more conductors, usually within an enveloping protective sheath, in such structural arrangement of the individual conductors as will permit of their use separately or in groups.

CALLING SEQUENCE

A sequence of instructions, parameters and parameter addresses. The calling sequence specifies the entry to the subroutine and uniquely determines by its parameters the action to be performed. A minimum calling sequence consists of an entry specification only.

CARD CODE

See Hollerith.

CARD IMAGE

The arrangement of information in memory resulting from a computer read of a punched card. The information arrangement required for a computer output of a card. A card image is hardware dependent, varying from computer to computer.

CARRIER

- 1) High-frequency current on which voice or signalling channels can be modulated.
- 2) Wave suitable for modulating by the intelligence to be transmitted over a communication system. The component of a transmitted wave upon which an audio signal or other form of intelligence can be impressed. The carrier can be a high frequency current superimposed on a voice circuit, on which can be modulated additional voice or signalling channels.

CARRIER, COMMON

U.S. - A company recognized by the US Federal Communications Commission or appropriate state agency as having a vested interest in furnishing a communications service to the public.

Such services are recognized as "voice" or "written messages".

Under this definition, American Telephone & Telegraph, Western Union Co., General Tel. and Electronics and some 4,000 independent telephone companies are common carriers.

CARRIER FREQUENCY

The carrier frequency is the frequency of the unmodulated carrier wave, if sinusoidal, or the center frequency of the unmodulated carrier when a recurring series of pulses are used.

CARRY

1) A condition occurring during addition when the sum of two digits in the same column equal or exceeds the number base; 2) The digit to be added to the next higher column; 3) The process of forwarding the carry digit.

CENTRAL PROCESSOR

The portion of any computer that consists of the Arithmetic Unit, the Control Unit, and the Storage Unit.

CHAD

The circular piece of paper removed from tape where a hole is punched.

CHANNEL

A means of one way transmission. Several channels may share a common path as in carrier systems; in this case each channel is allotted a particular frequency band which is reserved to it.

CHARACTER

One of a set of elements which may be arranged in ordered groups to express information. Each character has two forms; 1) a man intelligible form, the graphic, including the decimal digits 0-9, the letters A-Z, punctuation marks, and other formatting and control symbols; and 2) its computer intelligible form, the code, consisting of a group of binary bits. Codes have been defined using 5, 6, 7 and 8 bit groups.

CHECKOUT

See debugging

CHARACTERISTIC

See Floating Point

CLEAR

To replace information in a storage device by zero (or blank, in some machines).

CLOSED LOOP

A family of automatic control units linked together with a process to form an endless chain. The effects of control action are constantly measured so that if the process goes off the beam, the control units pitch in to bring it back into line.

CLOSED-SHOP

This is intended to mean that mode of computing machine support wherein the applied programs and utility routines are written by members of a specialized group whose only professional concern is the use of computers.

CODE

See Character

CODE

To prepare coding.

CODING

The ordered set of computer instructions required to perform a given action or solve a given problem.

CODING, ABSOLUTE

Coding in the numeric language form acceptable to the computer arithmetic and control unit.

CODING, DERELATIVIZED

Absolute coding with all relative addresses modified by addition of their instruction's Base Addresses.

CODING, DYNAMICALLY RELOCATABLE

Relocatable coding for a computer which has special hardware to perform the derelativization.

CODING, RELOCATABLE

Absolute Coding containing relative addresses, which when derelativized, may be loaded into any portion of a computer's programmable memory and will execute the given action properly. The loader program normally performs the derelativization. In GE/PAC, the derelativization is accomplished by hardware.

CODING, SYMBOLIC

The language for an Assembly Programming Systems, e.g., PAL language. In general, each symbolic language statement corresponds to one computer instruction. See Macro instruction.

COLLATE

To merge items from two or more similarly sequenced files into one sequenced file, without necessarily including all items from the original files.

COMMAND

A pulse, signal, or set of signals initiating one step in the performance of a computer operation. See Instruction.

COMMON LANGUAGE

A language having national or international usage, for which processor programs are available to translate it into the absolute coding required for many different computers.

COMPARATOR

A device for comparing two different transcriptions of the same information to verify the accuracy of transcription, storage, arithmetic operation or other process, in which a signal is given dependent upon the relative state of two items, i. e., larger, smaller, equal, difference, etc.

COMPARE

To examine the representation of a quantity relative to a reference quantity for purposes of discovering one of the following relationships: equality; greater than; less than. The discovered relationship is used to select one of several hardware or program actions.

COMPILER

A processor program for a Procedure Oriented Programming System.

COMPILER LANGUAGE

The source language for a Procedure Oriented Programming System, e. g., FORTRAN language.

COMPLEMENT

A quantity which is derived from a given quantity, expressed to the base n , by one of the following rules and which is frequently used to represent the negative of the given quantity. (a) Complement on n : subtract each digit of the given quantity from $n-1$, add unity to the least significant digit, and perform all resultant carries. For example, the twos complement of binary 11010 is 00110; the tens complement of decimal 456 is 544, (b) Complement on $n-1$: subtract each digit of the given quantity from $n-1$. For example, the ones complement of binary 11010 is 00101; the nines complement of decimal 456 is 543.

COMPUTER

Any device capable of accepting information, applying prescribed processes to the information, and supplying the results of these processes; sometimes, more specifically, a device for performing sequences of arithmetic and logical operations; sometimes, still more specifically, a stored-program digital computer capable of performing sequences of internally-stored instructions, as opposed to calculators on which the sequence is impressed manually (desk calculator) or from tape or cards (card programmed calculator).

COMPUTER, OFF-LINE

The computer is not actively monitoring or controlling a process.

COMPUTER, ON-LINE

Computer is actively monitoring or controlling a process.

COMPUTER LIMITED

A program which time shares computation with Input/Output but is unable to fully utilize the I/O equipment because the computation time exceeds the I/O time. See I/O Limited.

CONDITIONAL JUMP

A conditional branch instruction which implicitly specifies the branch address to be one of the next two or three sequential addresses.

CONNECTOR

In flow charting, a symbol used to indicate the interconnection of two points in the flow chart.

CONTENTS

The information stored in any stored medium.

CONTROL, CLOSED-LOOP

An operation where the computer applies control action directly to the process without manual intervention. See Closed Loop.

CONTROL, OPEN-LOOP

An operation when computer-evaluated control action is applied by an operator. See Open Loop.

CONTROL UNIT

That portion of a computer which directs the automatic operation of the computer, interprets computer instructions, and initiates the proper signals to the other computer circuits to execute instructions.

CONVERSION

(1) Changing the form of representation of information, such as from the language of one type of magnetic tape to that of another. (2) The process of changing the information and (sometimes) methods of a data processing operation to a different method. For instance, we speak of conversion from tabulating equipment to computer processing.

COOL

A contraction for Control Or Language. A programming system designed to simplify programming of General Electric Process Computers.

CORE MEMORY

A programmable random access memory consisting of many ferromagnetic toroids strung on wires in matrix arrays. Each toroid acts as an electromagnet to store a binary digit. A core memory has zero latency time.

CONTROL VALUE

Digital representation of an analog value.

COUNTER

A device or location which can be set to an initial number and increased or decreased by an arbitrary number by stimuli applied one at a time.

CROSSTALK

The unwanted transfer of energy from one circuit, called the "disturbing" circuit, to another circuit, called the "disturbed" circuit -e.g.- voice communication heard in a given circuit originating in an adjacent circuit.

CYCLE

A set of operations repeated as a unit; a non-arithmetic shift in which the digits dropped off at one end of a word are returned at the other end in circular fashion; cycle right and cycle left. To repeat a set of operations a prescribed number of times including, when required, supplying necessary address changes by arithmetic processes or by means of a hardware device such as a B-box or cycle-counter.

DATA

A collection of facts, numeric and alphabetical characters, etc., which is processed or produced by a computer. Data is properly plural, the singular form being datum but, in common computer usage "data" is taken as plural or singular.

DATA LINK

Equipment which permits the transmission of information in data format.

DATA PROCESSING

A generic term for all the operations carried out on data according to precise rules or procedures; a generic term for computing in general as applied to business situations.

DATA TRANSMISSION

This term has been all inclusive to describe the transfer of business data, destined generally to machines.

In a strict sense data transmission means the transmission of data-comprising digital information which is intelligible to both humans and machines.

db

Abbreviation for "decibel". A unit expressing the ratio of two voltages, currents, or powers. It is equal to 20 times the common logarithm of the ratio of two voltages across or two currents through equal loads, or 10 times the common logarithm of the two powers. One db is approximately the smallest change in audible power that can be recognized by the human ear.

dbm

Abbreviation for "decibels above (or below) one milliwatt". A level of power referred to an arbitrary one milliwatt standard.

DEBUGGING

The process of determining the correctness of a computer routine, locating any errors in it, and correcting them. Also the detection and correction of malfunctions in the computer itself.

DEBUGGED PROGRAM

A program that will perform actions in the logical sequence expected and produce accurate answers to one or more test problems which have been specifically designed to execute all foreseeable paths through the program.

DEBUGGING, ON-LINE

The act of debugging a program while time sharing its execution with an on-line process program. On-line debugging is accomplished in such a way that any attempt by the "slave" program undergoing debugging to interfere with the operation of the process program will be detected and inhibited.

DECODER

A device which accepts a code and transforms it into one of several predefined actions.

DECODING

(1) Internal hardware operations by which the computer determines the meaning of the operation code of an instruction. Also sometimes applied to addresses. (2) In interpretive routines, some sub-routines and elsewhere, an operation by which a routine determines the meaning of parameters.

DEMODULATOR

In a broad sense, a demodulator is a device which so operates on a carrier wave as to receive the wave with which the carrier was originally modulated.

DIAGNOSTIC ROUTINE

A test program used to detect and identify hardware malfunctions in the computer and its associated I/O equipment.

DIAL-UP

An expression to describe the ability to initiate a station-to-station telephone call, using a dial telephone, and effect the station connection desired purely as the result of dialing.

In connection with future systems, this term could also refer to a machine's ability to select a wanted telephone number and perform necessary dialing functions to obtain a connection.

DIGIT

One of the n symbols of integral value ranging from 0 to $n-1$ inclusive in a scale of numbering of base n , e.g., one of the ten decimal digits, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

DIGITAL DATA

Pertaining to physical quantities; where a physical quantity is expressed as a set of ordered digits enclosed in powers of a number base.

DIGITAL-TO-ANALOG (D/A) CONVERTER

A device which transforms digital data into analog data.

DISC MEMORY

A non-programmable bulk-storage, random access memory consisting of a magnetizable coating on one or both sides of a rotating thin circular plate. Memory latency time is of the order of hundreds of milliseconds.

DIVIDEND

See Quotient.

DIVISOR

See Quotient.

DOUBLE PRECISION

Data requiring two computer words to contain it. Often called Double Length.

DRIVER

Small programs that control external devices or execute other programs.

DRUM MEMORY

A memory consisting of a magnetizable coating on outer surface of a rotating cylinder. Drum memories are typically used in present day computers as non-programmable, bulk-storage random-access memories. Memory latency time is of the order of milliseconds.

DUMMY

See Identifier.

DUMP

A small program that outputs the contents of memory onto hard copy which may be listings, tape or punched cards.

DUPLEX CIRCUIT

A telegraph circuit permitting simultaneous two-way operation.

DUPLEX, FULL

Method of operation of a communication circuit where each end can simultaneously transmit and receive.

DUPLEX, HALF

Permits one direction, electrical communications between stations. Technical arrangements may permit operation in either direction but not simultaneously. Therefore, this term is qualified by one of the following suffixes: S/O for send only; R/O for receive only; S/R for send or receive.

DYNAMIC RELOCATION

See Coding, Dynamically Relocatable.

DYNAMIC PROGRAMMING

A mathematical theory of multi-stage decision processes.

ENCODER

A device which will accept one of several discrete input signals and transform it into a predefined code.

ENGINEERING UNITS

Units of measure as applied to a process variable, e.g., PSI, Degrees F., etc.

EXCHANGE

One or more central offices with associated plant and stations in a specified area, usually with a single rate of charges.

EXCLUSIVE OR

A logical operator which has the property such that if X and Y are two logic variables, then the functions "X ERA Y" is defined by the following table:

X	Y	X <u>ERA</u> Y
0	0	0
0	1	1
1	0	1
1	1	0

The ERA operator is usually represented in electrical notation by an encircled plus sign " $\oplus$ "; there is no equivalent FORTRAN symbol.

EXECUTIVE CONTROL PROGRAM

A main system program designed to establish priorities and to process and control other routines.

EXTERNAL STORAGE

See Memory, Off-line.

EXTRACT

To remove from a set of items of information all those items that meet some arbitrary criterion.

FACSIMILE

Transmission of pictures, maps, diagrams, etc., by wire. The image is scanned at the transmitter and reconstructed at the receiving station.

FIELD

A set of one or more adjacent columns on a punched card(s) or one or more bit positions in a complete word(s) consistently used to record similar information.

FILE

A collection of records; an organized collection of information directed toward some purpose. The records in a file may or may not be sequenced according to a key contained in each record.

FILE MAINTENANCE

The processing of a master file required to handle the non-periodic changes in it. Examples: Changes in number of dependents in a payroll file, the addition of new checking accounts in a bank.

FILTER

- 1) Device used in a frequency transmission circuit to exclude unwanted frequencies and to keep the channels separate.
- 2) Device to suppress interference which would appear as noise.

FIX

To convert data from floating-point number representation to fixed point representation.

FIXED POINT

A notation or system of arithmetic in which all numeric quantities are expressed by a predetermined number of digits with the point implicitly located at some predetermined position; contrasted with floating point.

FLAG

A bit (or bits) used to store one bit of information. A flag has two stable states and is the software analogy of a flip-flop.

FLIP-FLOP

A bi-stable device; a device capable of assuming two stable states; a bi-stable device which may assume a given stable state depending upon the pulse history of one or more input points and having one or more output points. The device is capable of storing a bit of information; controlling gates, etc.; a toggle.

FLOAT

To convert data from fixed-point number representation to floating-point representation.

FLOATING POINT

A form of number representation in which quantities are represented by a bounded number (mantissa) and a scale factor (Characteristic or Exponent) consisting of a power of the number base, e.g., $127.6 = 0.1276 \times 10^3$ where the bounds are 0 and 1.

FLOW CHART

A graphical representation of a sequence of operations, using symbols to represent the operations such as compute, substitute, compare, GO TO, IF, read, write, etc. Flow Charts of different levels of generality can be drawn for a given problem solution. Terms used are: System flow chart, program flow chart, coding level flow chart, etc.

FORMAT

The predetermined arrangement of characters, fields, lines, page numbers, punctuation marks, etc. Refers to input, output and files.

FORTRAN

Formula Translator - the language for a scientific procedural programming system.

FORTRAN COMPILER

A processor program for FORTRAN.

FREQUENCY

Rate in "cycles (kilocycles or megacycles) per second" at which a current alternates.

FREQUENCY SPECTRUM DESIGNATION

VLF (very low frequency). Below 30 kc/s (0.03mc/s).
LF (low frequency). 30 to 300 kc/s (0.03mc/s).
MF (medium frequency).. 300 to 3,000 kc/s
(0.03 to 3mc/s).
HF (high frequency). 3,000 to 30,000 kc/s
(3 to 30 mc/s).
VHF (very high frequency). . . . 30 to 300 mc/s.
UHF (ultrahigh frequency). . . 300 to 3,000 mc/s.
SHF (superhigh frequency). . . 3,000 to 30,000 mc/s.
EHF (extremely high frequency). . . 30,000 to
300,000 mc/s.

FREQUENCY, VOICE

A voice frequency is a frequency lying within that part of the audio range which is employed for the transmission of speech.

Note: Voice frequencies used for commercial transmission of speech usually lie within the range 200 to 3500 cycles per second.

FULL-DUPLEX OPERATION

Full-duplex, or duplex, operation refers to communication between two points in both directions simultaneously.

FUNCTION TABLE

Two or more sets of information so arranged that an entry in one set selects one or more entries in the remaining sets; a dictionary; a device constructed of hardware, or a sub-routine, which can either (a) decode multiple input into a single output or (b) encode a single input into multiple outputs; a tabulation of the values of a function for a set of values of the variable.

GARBAGE

Unwanted and meaningless information in memory.

GENERATOR

A program designed to create specific routines from specific input parameters and skeletal coding.

GENERATOR

A device which transforms mechanical energy into electrical energy.

GE/PAC

General Electric Process Automation Computer

GRAPHIC

See Character

HALF-DUPLEX SERVICE

In which the data communication channel is capable of transmitting and receiving signals, but is not equipped for simultaneous and independent transmission and reception.

HARD COPY

Any form of computer produced printed document.

HARDWARE

The mechanical, magnetic, electrical and electronic devices of which a computer is built.

HOLLERITH

A 12-bit code used for recording characters in punched-card memories.

HOUSEKEEPING

Operations in a routine which do not directly contribute to the solution of the problem at hand, but which are made necessary by the method of operation of the computer. Examples: Loop testing, tape sentinels, record grouping. Also called red tape operations.

IDENTIFIER

A symbol whose purpose is to identify, indicate or name a body of data.

INDEX

An integer used to specify the location of information within a table or program.

INDEX ADDRESS MODIFICATION (INDEXING)

See Address Modification.

INDEX REGISTER

A memory device containing an index.

INFORMATION CHANNEL

The transmission and intervening equipment involved in the transfer of information in a given direction between two terminals.

An information channel includes the modulator and demodulator, and any error-control equipment irrespective of its location, as well as the backward channel when provided.

INDIRECT ADDRESSING

See Address, Indirect

INITIALIZE

A program or hardware circuit which will return a program, a system or a hardware device to an original state.

I/O LIMITED

A program which time shares computation with Input/Output but is unable to full utilize the central processor because the I/O equipment is unable to keep up with the program's demands for data input and output.

INSTRUCTION

A set of bits which will cause a computer to perform certain prescribed operations. A computer instruction consists of:

- 1) an operation code which specifies the operation(s) to be performed.
- 2) one or more operands (or addresses of operands in memory).
- 3) one or more modifiers (or addresses of modifiers) used to modify the operand or its address.

INSTRUMENTATION

The application of devices for the measuring, recording and/or controlling of physical properties and movements.

INTEGRATED PROCESS CONTROL

GE/PAC 4000 process computers combine with Directo-Matic II controls for Integrated Process Control.

ITEM

A set of one or more fields containing related information; a unit of correlated information relating to a single person or object; the contents of a single message.

INTERFACE

A concept involving the specification of the interconnection between two equipments having different functions.

INTERLACED MEMORY

A memory with sequentially addressed locations occupying physically separated positions in the storage media.

INTERNAL STORAGE

See Memory, on-line.

INTERPRETIVE ROUTINE

A routine which carries out problem solution by process of: (1) decoding instructions written in a pseudo-code, and selecting and executing an appropriate sub-routine to carry out the functions called for by the pseudo-code. (2) Proceeding to the next pseudo-instruction. It should be noted that an interpretive routine carries out its functions as it decodes the pseudo-code, as contrasted to a compiler, which only prepares a machine-language routine which will be executed later.

INTERRUPT

A break in the normal flow of a system or program occurring in such a way that the flow can be resumed from that point at a later time. Interrupts are initiated by signals of two types:

- 1) Signals originating within the computer system to synchronize the operation of various components.
- 2) Signals originating exterior to the computer system to synchronize the operation of the computer system with the outside world (e.g., an operator or a physical process).

KEY

The field or fields of information by which a record in a file is identified, and/or controlled.

KEYBOARD LOCKOUT

An interlock feature which prevents sending from the keyboard while the tape transmitter or another station is sending on the same circuit, to avoid breaking up the transmission by simultaneous sending.

LABEL (PROGRAM)

An ordered set of characters used to symbolically identify an instruction, a program, a quantity, or a data area. The label also symbolically designates the memory location which is to contain the instruction, etc. The label is, therefore, the symbolic analog of an address. A label may be absolute, relative, direct, or indirect. See Address.

LABEL (TAPE)

- 1) A paper label attached to a tape reel to identify its contents.
- 2) The first record on a tape. The label identifies the contents of the tape.

LATENCY

See Memory Latency Time.

LEFT JUSTIFIED

A field of numbers (decimal, binary, etc.) which exists in a memory cell, location or register, possessing no zeros to its left.

3	9	2	7	6	4	0	0	5	0
---	---	---	---	---	---	---	---	---	---

LIBRARY PROGRAMS

A software collection of standard and proved routines and sub-routines by which problems and parts of problems may be solved on a given computer.

LINE PRINTER

A printing device that can simultaneously print several character graphics on hard copy. A line typically consists of 120 characters.

LINKAGE

A means of communicating information from one routine to another.

LINEAR PROGRAMMING

A form of Mathematical Programming in which each variable is expressed as a linear function of the parameters.

LIST

An ordered set of items contained within a memory in such a way that only two items are readily program addressable. These items are the earliest appended (beginning item) and the most recently appended (ending item). Items stored into the list are "appended" following the ending item. Items read from the list are "removed".

LIST, PUSH-DOWN

A list frequently used in data processing. Both appends and removals are made at its end.

LIST, QUEUING

A list frequently used for scheduling actions in real time on a time-priority basis. Appends are made following the ending item. The beginning item is always the removed item.

LOADER

A program that operates on input devices to transfer information from off-line memory to on-line memory.

LOCATION

The contiguous set of bit positions in a memory uniquely specified by an address.

See Address; Word

LOGGER

A device which automatically records physical processes and events, usually with respect to time.

LOGICAL OPERATIONS

See Boolean Algebra

LOOP

A coding technique whereby a group of instructions is repeated a specified number of times, usually with some modification to certain instructions in the group.

LOOP, CLOSED

A family of automatic control units, one of which may be a computer, linked together with a process to form an endless chain.

LOOP, OPEN

A family of automatic control units, one of which may be a computer, linked together manually by operator action.

MACHINE LANGUAGE CODING

See Coding, Absolute

MACRO INSTRUCTION

A symbolic language statement for a Macro-Assembly Programming System. A statement can correspond to several computer instructions. See Coding, Symbolic.

MALFUNCTION

A failure in the operation of the hardware of a computer.

MANTISSA

See Floating Point

MASK

A machine word that specifies which parts of another machine word are to be operated on.

MATHEMATICAL PROGRAMMING

A mathematical theory for optimizing a set of variables controlling a process for a given set of parameters.

MEMORY

A device or media used to store information in a form that can be understood by the computer hardware.

MEMORY ACCESS TIME

See Access Time

MEMORY ADDRESSABILITY

See Addressability, Memory

MEMORY, BULK STORAGE

Any non-programmable large memory.

MEMORY, CARD

An off-line Bulk Storage memory. Memory media is a rectangular array of 960 bit positions on the card. Bits are specified by holes in these positions.

MEMORY, CORE

See Core Memory

MEMORY CYCLE TIME

The minimum time between two successive data accesses from a memory.

MEMORY, DISC

See Disc Memory

MEMORY, DRUM

See Drum Memory

MEMORY LATENCY TIME

The time required for the memory's control hardware to physically move the memory media containing the desired data to a position where it can be electrically read. Alternately the reading device may be moved to the desired data. Latency is associated with serial memories and certain random-access memories.

MEMORY, OFF-LINE

Any memory media, capable of being stored remotely from the computer, which can be read by the computer when placed into a suitable reading device.

MEMORY, ON-LINE

A memory media used as a non-removable part of a computer system.

MEMORY, PROGRAMMABLE

A memory whose locations are addressable by the computers program counter, i.e., a program within this memory may directly control the operation of the Arithmetic and Control Unit.

MEMORY, RANDOM ACCESS

A memory whose information media is organized into discrete locations, sectors, etc., each uniquely identified by an address. Data may be obtained from such a memory by specifying the data address(es) to the memory e.g., core, drum, disc, cards.

MEMORY, SERIAL

A memory whose information media is continuous. Data is identified in its content or form. Data may be obtained only by performing a serial search through the contents of the memory.

MEMORY, TAPE

A serial, bulk-storage, off-line memory. Two forms are common: Paper Tape; Magnetic Tape.

MERGE

To produce a single sequence of items, ordered according to some rule (i.e., arranged in some orderly sequence), from two or more sequences previously ordered according to the same rule, without changing the items in size, structure, or total number. Merging is a special case of collation.

MESSAGE

A group of words, variable in length, transported item of information.

MESSAGE

A communication of information or advice from a source to one or more destinations in suitable language or code. In telegraphic and data communications a message is composed of three parts as follows:

- 1) A heading containing a suitable indicator of the beginning of the specific message together with information on any or all of the following: the source and destination, data and time of filing, and routing or other transmission information;
- 2) A body containing the information or advice to be communicated;
- 3) An ending containing a suitable indicator of the conclusion of the specific message, either explicit or implicit.

MICROSECOND

One-millionth of a second.

MILLISECOND

One-thousandth of a second.

MNEMONIC

Assisting or intended to assist, memory; of or pertaining to memory; mnemonics is the art of improving the efficiency of the memory (in computer storage). See also Label.

MODEM

A contraction of "modulator-demodulator". The term may be used with two different meanings:

- a) the modulator and the demodulator of a modem are associated at the same end of a circuit;
- b) the modulator and the demodulator of a modem are associated at the opposite ends to form a channel.

MODIFIER

A quantity used to alter the address of an operand, e.g., the cycle index. See Address Modification.

MODULATION

Process by which certain characteristics of a wave are modified in accordance with a characteristic of another wave or a signal.

MODULATION, AMPLITUDE

(AM)

Amplitude modulation is modulation in which the amplitude of a wave is the characteristic varied.

MODULATION, FREQUENCY

Angle modulation in which the instantaneous frequency of a sine wave carrier is caused to depart from the carrier frequency by an amount proportional to the instantaneous amplitude of the modulating wave.

MODULATION, PHASE (PM)

Phase modulation is angle modulation in which the angle of a sine wave carrier is caused to depart from the carrier angle by an amount proportional to the instantaneous value of the modulating wave.

MONITOR

An operating programming system which provides a uniform method for handling the real-time aspects of program timing, such as scheduling and basic input/output functions.

MULTIPLICAND

See Product.

MULTIPLIER

See Product.

MULTI PROGRAMMING

A technique for handling numerous routines or programs seemingly simultaneously by overlapping or interleaving their execution, that is, by permitting more than one program to time-share machine components.

NETWORK-LEASED LINE

May refer to either a telephone or teletype network; usually has reference to a telephone net.

NETWORK-PRIVATE WIRE

May refer to either private telephone or teletype network.

NETWORK-TELEPHONE

Describes a system of points inter-connected by private voice-grade telephone wire whereby direct point-to-point telephone communications are provided. This traffic usually by-passes commercial telephone switching facilities; the customer provides his own operating personnel for leased lines and facilities. Service is available from local common carriers.

NETWORK-TELETYPE

Describes a system of points, interconnected by private telegraph channels, which provide hard copy and/or telegraphic coded (5-channel) punched paper tape, as required, at both sending and receiving points. Typically, up to 20 way-stations share send-receive time on a single circuit, and can exchange information without requiring action at a switching center. If two or more circuits are provided, a switching center is required to permit cross-circuit transmission.

Such networks are available on a monthly rental plus one-time installation charge basis.

NOISE

An extraneous signal in an electrical circuit capable of interfering with the desired signal. Loosely, any disturbance tending to interfere with the normal operation of a device or system.

NOT

A logic operator having the property that if P is a logic quantity then the quantity "NOT P" assumes values as defined in the following table:

<u>P</u>	<u>NOT P</u>
0	1
1	0

The NOT operator is represented in electrical notation by an overline, e.g., $\overline{P}$, and in FORTRAN by a minus sign in a Boolean expression.

NUMBER

1. A mathematical entity that may indicate quantity or amount of units.
2. Loosely, a numeral.

NUMBER SYSTEM

Loosely, a numeration system.

NUMERAL

A representation of a number.

NUMERATION SYSTEM

A system for the representation of numbers, e.g., decimal system, roman numeral system, 2's complement binary system.

NUMERICAL CONTROL

Pertaining to the automatic control of Processes by the proper machine interpretation of numerical data.

OBJECT MACHINE

The computer on which the object program is to be executed.

OBJECT PROGRAM

The absolute coding output by a Processor Program. See Source Program.

OCTAL

Pertaining to the number base 8. Pertaining to any set of exactly 8 characteristics.

OFFSET

The count value output from an A/D converter resulting from a zero input analog voltage. Used to convert subsequent non-zero measurements.

OPERAND

Any quantities entering or arising in an operation. An operand may be an argument, a result, a parameter, or an indication of the location of the next instruction.

OPERATING SYSTEM

A group of programming systems operating under control of a data processing monitor program.

OPERATION (ØP) CODE

That part of an instruction designating the operation to be performed.

OPERATION, PARALLEL

Operates on all bits of a word simultaneously.

OPERATION, SERIAL

The flow of information through a computer in time sequence, usually by bit but sometimes by character.

OPERATIONAL

The status of a computer or program when it has been running correctly, using line data, for sometime.

OR

A logic operator having the property that if P and Q are logic quantities then the quantity "P OR Q" assumes values as defined by the following table:

P	Q	P <u>OR</u> Q
0	0	0
0	1	1
1	0	1
1	1	1

The OR operator is represented in both electrical and FORTRAN terminology by a "+", i. e., $P + Q$.

OR GATE

An electric circuit that implements the OR operator.

ORIGIN

In coding, the absolute memory address of the first location of a program or program segment.

OUTPUT

Information transferred from the internal storage of a computer to output devices or external storage.

OVERFLOW

In an arithmetic operation, the generation of a quantity beyond the capacity of the register or location which is to receive the result; over-capacity; the information contained in an item of information which is in excess of a given amount.

OVERLAY

A technique for bringing routines into high-speed memory from some other form of storage during processing, so that several routines will occupy the same storage locations at different times; used when the total memory requirements for instructions exceed the available high-speed memory. Also see Segment.

PACK

To insert data into one or more fields of a multi-field memory locations.

PARAMETER

In a sub-routine, a quantity which may be given different values when the sub-routine is used in different main routines or in different parts of one main routine, but which usually remains unchanged throughout any one such use; in a generator, a quantity used to specify input/output devices, to designate sub-routines to be included, or otherwise to describe the desired routine to be generated.

PARITY BIT

A binary digit appended to an array of bits to make the sum of all the bits always odd or always even.

PARITY CHECK

A check that tests whether the number of ones (or zeros) in an array of binary digits is odd or even.

PATCH

Section of coding inserted into a routine to correct a mistake or alter the routine; explicitly transferring control from a routine to a section of coding and back again.

PERIPHERAL

Input/output equipment used to make hard copies or to read in data from hard copies (typer, punch, tape reader, line printer, etc.). Paper tape is considered hard copy for this definition.

PILOT

In a transmission system, a pilot is a signal wave, usually a single frequency, transmitted over the system to indicate or control its characteristics.

PRECISION

The degree of discrimination with which a quantity is stated, e. g., a three digit numeral discriminates among 1000 possibilities. Precision is contrasted with accuracy, e. g., a quantity expressed with 10 decimal digits of precision may only have one digit of accuracy. See Accurate.

PRIORITY

Order of importance.

PROBLEM ORIENTED LANGUAGE

A source language oriented to the description of a particular class of problems, e. g., COOL, Report Generator Languages.

PROCEDURAL ORIENTED LANGUAGE

A source language oriented to the description of procedural steps in machine computing, e. g., FORTRAN.

PROCESSOR

The translating routine of a programming system.

PROGRAM

A plan for the solution of a problem. A complete program includes plans for the transcription of data, coding for the computer and plans for the absorption of the results into the system. The list of coded instructions is called a routine; to plan a computation or process from the asking of a question to the delivery of the results, including the integration of the operation into an existing system. This programming consists of planning and coding, including numerical analysis, systems analysis, specification of printing formats, and any other functions necessary to the integration of a computer in a system.

PROGRAM, RELOCATABLE

See Coding, Relocatable.

PROGRAMMING SYSTEM

A system consisting of a programming language and a computer program, the Processor, to convert the language into absolute coding.

PROPAGATION

Traveling of a wave along a transmission path.

PSEUDO (ØP) INSTRUCTION

A symbolic representation of information to a compiler or interpreter; a group of characters having the same general form as a computer instruction, but never executed by the computer as an actual instruction.

PULSE

A change in the intensity or level of some medium, usually over a relatively short period of time, e.g., a shift in electric potential of a point for a short period of time compared to the time period, i.e., if the voltage level of a point shifts from -10 to +20 volts with respect to ground for a period of 2 microseconds, one says that the point received a 30 volt 2 microsecond pulse.

PULSE

A signal characterized by the rise and decay in time of a quantity whose value is normally constant.

PUNCHED CARD

A piece of lightweight cardboard on which information is represented by holes punched in specific positions.

PUNCHED PAPER TAPE

A strip of paper on which characters are represented by combinations of holes.

PUSH DOWN LIST

See List, Push-down.

PUSH UP LIST

See List, Queing.

QUEUE

Waiting lines resulting from temporary delays in providing service.

QUEING TABLE

See List, Queing.

QUOTIENT

The quantity resulting from the division of a dividend by a divisor. If the dividend is not an even multiple of the divisor, the quantity left over is the remainder.

RADIX,

See Base.

RANDOM ACCESS STORAGE

See Memory, Random Access.

RANGE

A characterization of a variable or function. All the values which a function may have.

RATIO, SIGNAL-TO-NOISE

(Signal-Noise Ratio)

The signal-to-noise ratio is the ratio of the magnitude of the signal to that of the noise. This ratio is often expressed decibels.

RAW DATA

Data which has not been processed; may or may not be in machine-sensible form.

READ

To copy, usually from one form of storage to another, particularly from external or secondary storage to internal storage; to sense the meaning of arrangements of hardware; to sense the presence of information on a recording medium.

READER

A device capable of sensing information stored in an off-line memory media (cards, paper tape, magnetic tape) and generating equivalent information in an on-line memory device (register, memory locations).

REAL TIME

- 1) Pertaining to the actual time during which a physical process transpires.
- 2) Pertaining to the performance of a computation during the actual time that the related physical process transpires in order that results of the computation can be used in guiding the physical process.

RECEIVER

A device which transforms a varying electrical signal into sound waves or other usable form.

RECORD

A collection of fields; the information relating to one area of activity in a data processing activity, i.e., all information on one inventory item. Sometimes called item.

RECURSION

The continued repetition of the same operation or group of operations.

REGISTER

A memory device capable of containing one or more computer bits or words. A register has zero memory latency time and negligible memory access time.

REPEATER

A device whereby currents received over one circuit are automatically repeated in another circuit or circuits, generally in an amplified form.

RESET

To return a register or storage location to zero or to a specified initial condition.

RIGHT JUSTIFIED

A field of numbers (decimal, binary, etc.) which exists in a memory cell, location, or register possessing no significant zeros to its right is considered to be right justified. 0 0 0 1 2 0 0 0 0 0 is considered to be a seven-digit field right justified. 0 0 0 0 0 0 0 1 2 0 0 is a two-digit field not right justified.

ROUND OFF

To delete the least significant digit(s) of a numeral and to adjust the past retained in accordance with some rule.

ROUTINE

A series of computer instructions which performs a specific, limited task.

ROUTINE, INTERPRETIVE

A routine which carries out problem solution by process of: (1) Decoding instructions written in a pseudo-code, and selecting and executing an appropriate sub-routine to carry out the functions called for by the pseudo-code. (2) Proceeding to the next pseudo-instruction. It should be noted that an interpretive routine carries out its functions as it decodes the pseudo-code, as contrasted to a compiler, which prepares a machine-language routine which will be executed later.

ROUTINE, SERVICE

A routine designed to assist in the actual operation of the computer. Tape comparison, block location, certain post mortems, and corrections routines fall into this class.

RUN

One performance of a program on a computer; performance of one routine, or several routines automatically linked so that they form an operating unit, during which manual manipulations are not required of the computer operator.

SCALE

To alter the units in which all variables are expressed, to bring all magnitudes within bounds dictated by need, register size, or other arbitrary limits.

SCALE FACTOR

One or more coefficients used to multiply or divide quantities in a problem in order to convert them to a given magnitude, e.g., plus one to minus one.

Actual Number	Number in Storage	Scale Factor
9.0	.0009	4
.0009	9.0	-4

SCANNER, ANALOG INPUT

A device which will, upon command, connect a specified sensor to measuring equipment and cause the generation of a digit count value which can be read by the computer.

SECTOR

A set of bits comprising the smallest addressable unit of information in a drum or disk memory.

SEGMENT

Part of a Segmented Program.

SEGMENTED PROGRAM

A program that has been divided into parts (segments) in such a manner that:

- 1) Each segment is self contained. Only one segment must be in the computer's programmable memory at any given time. The remaining segments may reside in Bulk Storage Memory.
- 2) Interchange of information between segments is by means of data tables in known memory locations.
- 3) Each segment contains instructions to cause (or request a Monitor to cause) the transfer of the next segment into programmable memory. Segments need not overlay each other. See Overlay.

SENSOR

A transducer or other device whose input is a quantitative measure of some external physical phenomenon and whose output can be read by a computer.

SERIAL TRANSFER

A system of data transfer in which elements of information are transferred sequentially.

SERIAL TRANSMISSION

A system of transmitting bits of character in line sequence. Generally used in telegraphic operation.

SERVOMECHANISM

A closed loop system in which the error or deviation from a desired or preset norm is reduced to zero; An electromechanical device that orients itself to a master device by sensing and reducing its deviation signal, from the master, to zero.

SHIFT

To move information serially right or left in a register(s) of a computer. Information shifted out of a register may be lost, or it may be re-entered at the other end of the register.

SHIFT, ARITHMETIC

To shift a number in a register in order to scale the number. See Scale.

SIGN

The symbol or bit which distinguishes positive from negative numbers.

SIGNAL, START

(In a start-stop system)

Signal serving to prepare the receiving mechanism for the reception and registration of a character, or for the control of a function.

SIGNAL, STOP

(In a start-stop system)

Signal serving to bring the receiving mechanism to rest in preparation for the reception of the next telegraph signal.

SIGNAL, TELEGRAPH

The set of conventional elements established by the code to enable the transmission of a written character (letter, figure, punctuation sign, arithmetical sign, etc.) or the control of a particular function (spacing, shift, line-feed, carriage return, phase correction, etc.); this set of elements being characterized by the variety, the duration and the relative position of the component elements (or by some of these features).

SIGNIFICANT DIGIT

A digit that contributes to the precision of a numeral. The number of significant digits is counted beginning with the digit contributing the most value, called the most significant digit, and ending with the one contributing the least value, called the least significant digit.

SIMPLEX

Applied to a circuit that provides a one-way path for telegraph-type signals.

SIMULATOR

A device or computer program that performs simulation.

SOFTWARE

The collection of all programs for a computer.

SORT

To arrange items of information according to rules dependent upon a key or field contained in the items.

SOURCE PROGRAM

Program statements in the language of a Programming System, e.g., PAL is the source language of the PAL programming system.

STATEMENT

In computer programming, a meaningful expression or generalized instruction in a source language.

STORAGE

See Memory.

STORAGE, WORKING

See Working Storage.

STORE-AND-FORWARD SWITCHING CENTER

A message switching center in which the message is accepted from the sender whenever he offers it, held in a physical store, and forwarded to the receiver whenever he is able to accept it.

SUBROUTINE

A subroutine is a series of computer instructions to perform a specific task for many other routines. It is distinguishable from a main routine in that it requires as one of its parameters, a location specifying where to return to the main program after its function has been accomplished.

SUM

The quantity resulting from the addition of an addend to an augend.

SUPPORT SYSTEM

A programming system used to support the normal translating functions of machine oriented, procedural oriented, and problem oriented language Processors.

SWITCH

An interpretation of a location which will contain a variable unconditional branch or transfer instruction.

SWITCHING

Operations involved in interconnecting circuits in order to establish a temporary communication between two or more stations.

SWITCHING CENTER

An installation in a communication system in which switching equipment is used to interconnect communication circuits.

SYMBOL TABLE

A table of Labels and their corresponding numeric values.

SYMBOLIC CODING

Broadly, any coding system in which symbols other than actual machine operations and addresses are used.

SYNTAX

- 1) The structure of expressions in a language.
- 2) The rules governing the structure of a language.

SYSTEM

An assembly of components united by some form of regulated interaction to form an organized whole. A collection of procedures, men and machines, by which industrial or business activity is carried on.

TABLE

1) A collection of data, each item being uniquely identified either by some label or by its relative position.

2) See truth table.

TABLE LOOK-UP

A procedure for obtaining the function value corresponding to an argument from a table of function values.

TABULAR LANGUAGE

The language for a problem oriented programming system. The language format is tabular in nature, e.g., TASC.

TARIFF

Definitions and rates for charges for services.

TASC

(Tabular Sequences Control)

A symbolic language specifically developed to enable coding Utility Systems Sequence Control Programs in pseudo-English. Consists of a translator program to pack tables in machine language which will be used by sub-routines under control of an executive control type routine called the Table Analyzer.

TELECOMMUNICATION

Any process that enables a correspondent to pass to one or more given correspondents (telegraphy or telephony), or possible correspondents (broadcasting), information of any nature delivered in any usable form (written or printed matter, fixed or moving, pictures, words, music, visible or audible signals, signals controlling the functioning of mechanisms, etc.) by means of any electromagnetic system (electrical transmission by wire, radio transmission, optical transmission, etc., or a combination of such systems).

TELEGRAPH

Any system of communication employing nonverbal electric signals which pass over wires. Originally any form of communication over long distances in which messages were transmitted by signs or sounds was called telegraphy.

TELEGRAPH CHANNEL

The transmission media and intervening apparatus involved in the transmission of telegraph signals in a given direction, between two terminal sets, or more generally, between two intermediate telegraph installations.

A means of one-way transmission of telegraph signals.

A telegraph channel is characterized by the number of significant conditions and by the modulation rate; it is designed to transmit.

For example: A fifty-band channel for two-condition modulation.

TELEPRINTER

Trade name used to refer to printing telegraph equipment.

TELETYPEWRITER

Trade name used to refer to printing telegraph equipment.

TELPAK

A high-speed telephone or broad-band service. Telpaks has the wide band channels necessary for computer-to-computer communication and other special high-speed applications. There are presently four sizes of Telpak available.

Telpak A - Equivalent in capacity to 12 - voice circuits.

Telpak B - Equivalent in capacity to 24 - voice circuits.

Telpak C - Equivalent in capacity to 60 - voice circuits.

Telpak D - Equivalent in capacity to 240 - voice circuits.

TIMESHARE

To use a device for two or more interleaved purposes.

TORN TAPE SWITCHING

A manual switching system for teletype systems. Messages are received from one circuit in the form of punched paper tape which is then "torn" off and carried to a tape sender for retransmission to the destination. Normally, the incoming console, with tape punches, is placed opposite the outgoing console, with tape readers - with attendants operating between the two.

TRACING ROUTINE

A routine that provides a historical record of specified events in the execution of a program.

TRACK

The portion of a moving storage medium, such as a drum, tape, or disc, that is accessible to a given head position.

TRANSDUCER

A device for converting energy from one form to another.

TRANSFER VECTOR

A transfer table used to communicate between two or more programs. The table is fixed in relationship with the program for which it is the transfer vector. The transfer vector provides communication linkage between that program and any remaining sub-programs.

TRANSIENT

A phenomenon experiencing a change as a function of time; something which is temporary; a buildup or breakdown in the intensity of a phenomenon until a steady-state condition is reached; an aperiodic phenomenon. The time rate of change of energy is finite and some form of energy storage is usually involved.

TRAP

An unprogrammed conditional jump to a known location, automatically activated by hardware, with the location from which the jump occurred.

TROUBLESHOOT

See Debugging.

TRUNCATE

To terminate a computational process in accordance with some rule, e.g., to end the evaluation of a power series at a specified term.

TRUNK

A trunk is a telephone line or channel between two central offices or switching devices, which is used in providing telephone connections between subscribers.

TRUTH TABLE

A table that describes a logic function by listing all possible combinations of input values and indicating, for each combination, the true output values.

UNDERFLOW

Pertaining to the condition that arises when a machine computation yields a non-zero result that is smaller than the smallest non-zero quantity that the intended unit of storage is capable of storing.

UNPACK

To separate various sections of packed data.

VARIABLE

A quantity that can assume any of a given set of values.

**VOICE-FREQUENCY (VF);
TELEPHONE FREQUENCY**

Any frequency within that part of the audio-frequency range essential for the transmission of speech of commercial quality, i.e., 300-3400 c/s.

WADS

Wide Area Data Service.

WATS

Wide Area Telephone Service.

WAY-OPERATED CIRCUIT

A circuit shared by three or more stations on a "party line" basis. One of the stations may be a switching center. May be single or duplex circuit.

WORD

A set of bits comprising the smallest addressable unit of information in a programmable memory.

WORD LENGTH

The number of bits in a word.

WORD, TELEGRAPH (CONVENTIONAL)

A word comprising five letters together with one letter-space, used in computing telegraph speed in words/minute or traffic capacity.

WORD TIME

See Memory Cycle Time.

WORKING STORAGE

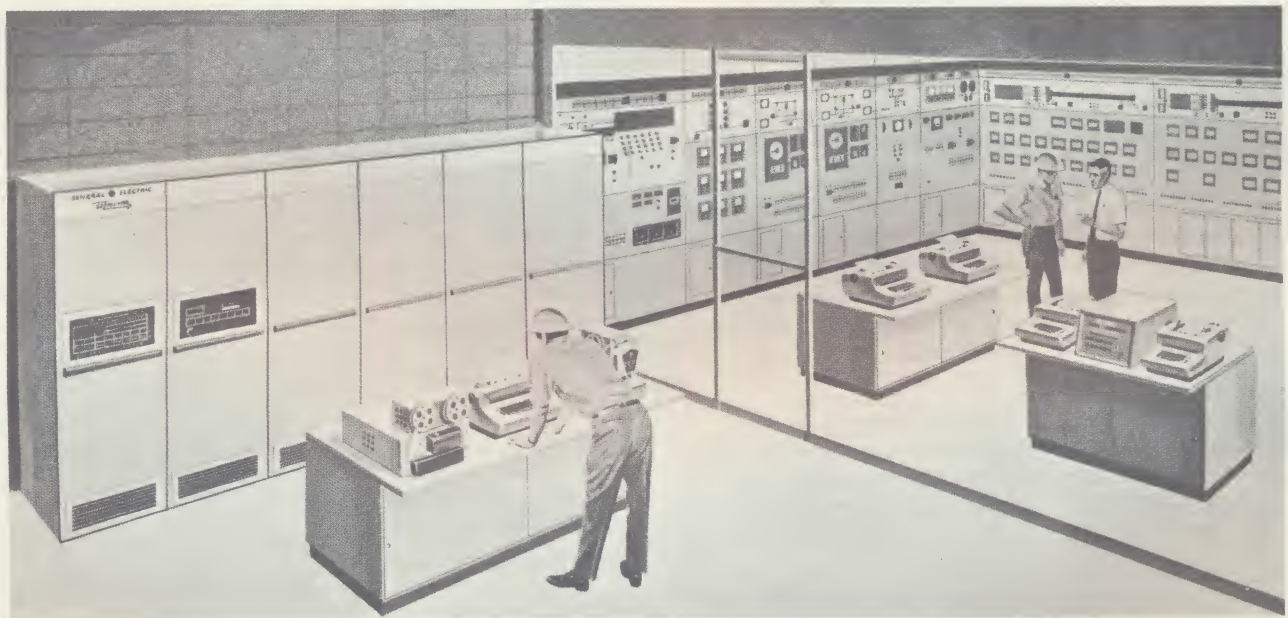
Programmable memory locations reserved for intermediate and partial results.

WRITE

To deliver data to a medium such as storage.

ZERO-SUPPRESSION

The elimination of nonsignificant zeros in a numeral.



Computer and control room with a GE/PAC Process Computer and peripherals